



# Developing Systems Engineering Graduate Programs Aligned to the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE™) Guidelines

**Alice Squires, [alice.squires@stevens.edu](mailto:alice.squires@stevens.edu)  
David Olwell, Tim Ferris, Nicole Hutchison,  
Art Pyster, Stephanie Enck**

2011 ASEE Annual Conference  
**T564: Developing Systems Engineering Curriculum, Part II**

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>JUN 2011</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2011 to 00-00-2011</b>	
4. TITLE AND SUBTITLE <b>Developing Systems Engineering Graduate Programs Aligned to the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE™) Guidelines</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Stevens Institute of Technology, Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE), 1 Castle Point on Hudson, Hoboken, NJ, 07030</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>Proceedings of the 2011 American Society for Engineering Education (ASEE) Conference held 26-29 Jun 2011, Vancouver, BC, Canada. BKCASE TM sponsored by Department of Defense. U.S. Government or Federal Rights License</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>15</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# What is BKCASE?

- Project to create:
  - **Systems Engineering Body of Knowledge (SEBoK)**
  - **Graduate Reference Curriculum in Systems Engineering (GRCSE™ – pronounced “Gracie”)**
- Started in September 2009 by Stevens Institute of Technology and Naval Postgraduate School with primary support from Department of Defense. Modeled on previous work for the Software Engineering community, but a bit more ambitious.
- Project will run through 2012
- Intended for world-wide use



NAVAL  
POSTGRADUATE  
SCHOOL



# What is the SEBoK?

Describes the boundaries, terminology, content, and structure of SE that are needed to systematically and consistently *support SE and to*

Task Name	Task Description
<i>Inform Practice</i>	Inform systems engineers about the boundaries, terminology, and structure of their discipline and point them to useful information needed to practice SE in any application domain
<i>Inform Research</i>	Inform researchers about the limitations and gaps in current SE knowledge that should help guide their research agenda
<i>Define Curricula</i>	Define the content that should be common in undergraduate and graduate programs in SE
<i>Certify Professionals</i>	Certify individuals as qualified to practice systems engineering
<i>Decide Competencies</i>	Decide which competencies practicing systems engineers should possess in various roles ranging from apprentice to expert

Guide to the literature, not all the content of the literature

# What is in GRCSE?

- ***Guidance for Constructing and Maintaining the Reference Curriculum:*** the fundamental principles, assumptions, and context for the reference curriculum authors
- ***Entrance Expectations:*** what students should be capable of and have experienced before they enter a graduate program
- ***Outcomes:*** what students should achieve by graduation
- ***Architecture:*** the structure of a curriculum to accommodate core material, university-specific material, and elective material
- ***Core Body of Knowledge:*** material that all students should master in a graduate SE program

Not specific courses. Not specific packaging. Adaption and selective adoption expected and encouraged.

# SEBoK 0.5 Anticipated TOC

- Part 1: A guide to the SEBoK itself – Why does it exist? What is in it? How will different people use it?
- Part 2: A guide to knowledge about systems – What types of systems exist? What fundamental principles help explain systems?
- Part 3: A guide to knowledge about SE practice – How is SE performed? What are typical SE activities?
- Part 4: What are specific considerations in the application of SE for: products, services, enterprises, Systems of Systems
- Part 5: When is SE performed? Who performs it? How is it enabled by an organization?
- Part 6: What other disciplines does SE interact with and how?
- Part 7: Implementation Examples – What do existing case studies reveal about SE knowledge and practice in various domains?

# Part Outline

- Part 1: SEBoK 0.5 Introduction
- Part 2: Systems
- Part 3: Systems Engineering and Management
- Part 4: Applications of Systems Engineering
- Part 5: Enabling the Organization to Perform Systems Engineering
- Part 6: Software Engineering, Project Management, and Specialty Engineering
- Part 7: Systems Engineering Implementation Examples

# Wiki Planned for SEBoK 0.5:

## bkcasewiki.org

Part 1  
Part 2  
Part 1  
KA 1

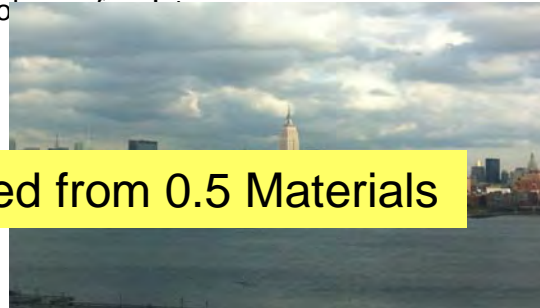
SEBoK Map:  
Generated from  
TOC

KA 3  
Part 4  
Part 5

### Topic 2 (Article Title)

Lorem ipsum dolor sit amet<sup>[1]</sup>, **consectetuer** adipiscing elit, sed diam nonummy nibh **euismod** tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor<sup>[2]</sup> in hendrerit in vulputate velit esse molestie **consequat**, vel illum do

nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril dele feugait n



Body – Generated from 0.5 Materials

Lorem ipsum<sup>[3]</sup> dolor sit amet, **consectetuer** adipiscing elit, sed diam nonummy nibh **euismod** tincidunt ut laoreet dolore magna aliquam erat **volutpat**. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat.<sup>[4]</sup>

Figure Caption

### Discussion Thread

Please provide any comments on Topic 2 below.

Comment Entry

Community Involvement & Conversation:  
Specific aspect of wiki development

Comment 1:  
Body of Comment  
Comment 2: User XXXX  
Body of Comment

### Related Topics

Topic 1  
Topic 2  
Topic 3  
Topic 4

.....  
Guidance  
Materials

**Citati** Citations,  
Citatio Glossary, and  
Citatio primary  
Citatio references –  
Citatio Generated from  
Citatio 0.5 materials

.....  
Related Primary  
References and  
Related topics:

**Relat** New efforts  
**F** unique to Wiki  
discussion

[Refere](#)

[Reference 2](#)

.....

### Glossary

[Term 1](#)

[Term 2](#)

[Term 3](#)

.....

# GRCSE Value Proposition

1. There is no authoritative source to guide universities in establishing the outcomes graduating students should achieve with a master's degree in SE, nor guidance on reasonable entrance expectations, curriculum architecture, or curriculum content.
2. This gap in guidance creates unnecessary inconsistency in student proficiency at graduation, makes it harder for students to select where to attend, and makes it harder for employers to evaluate prospective new graduates.

GRCSE is being created analogously to GSwE2009 – in fact, using GSwE2009 as the starting text

*Version 0.5 expected in December 2011*

# GRCSE 0.5 Anticipated TOC

## Title - Chapters

1. Introduction
2. Guidance for the construction of GRCSE
3. Expected student background when entering master's program
4. Expected objectives when a graduate has 3-5 years' experience
5. Expected outcomes when a student graduates
6. Curriculum architecture
7. Core body of knowledge (CorBOK)
8. Assessment
9. Future Management

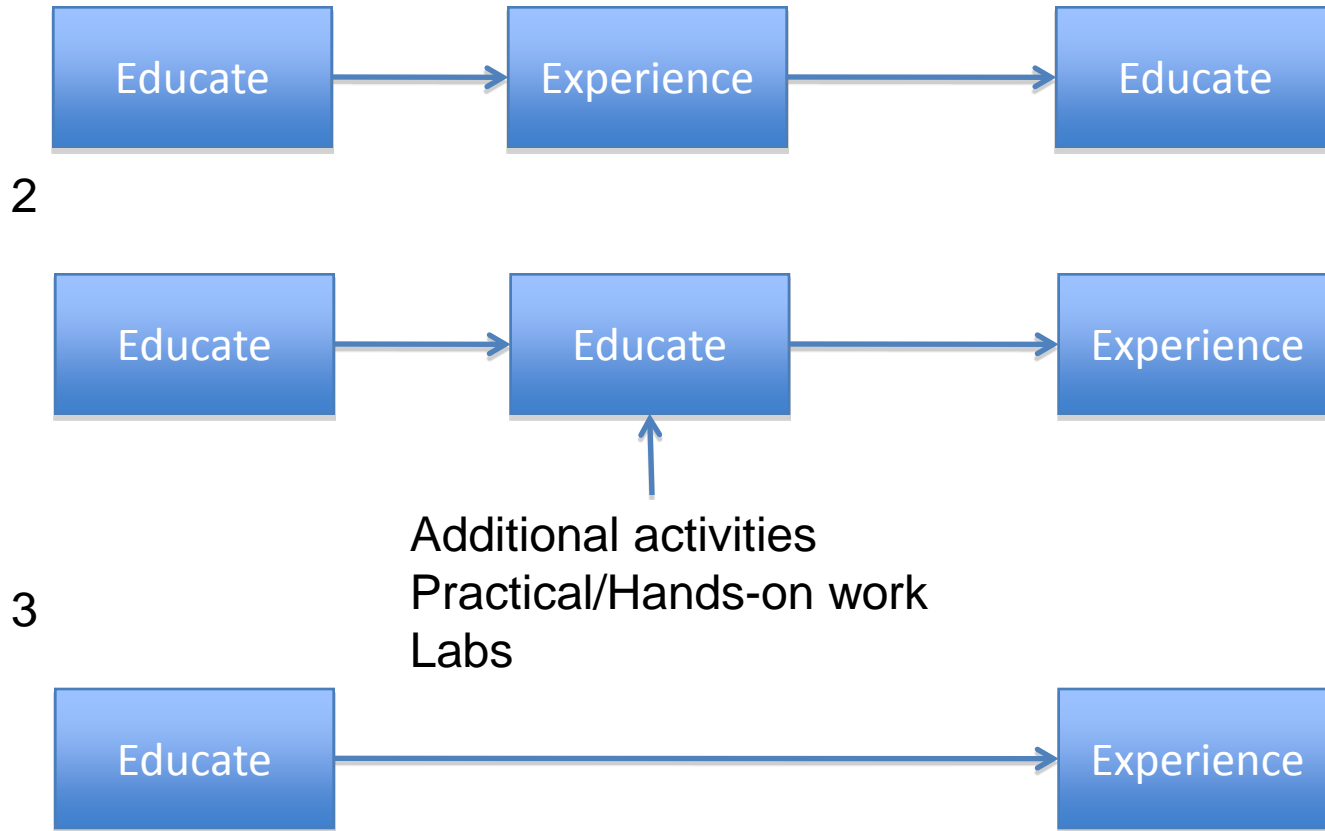
## Title - Appendices

- App A. Summary of Graduate SE-centric SE programs in 2010
- App B. Bloom's taxonomy of educational objectives
- App C. Systems engineering competency frameworks
- App D. Assessment and curriculum
- App E. GRCSE outcomes CorBOK mapping
- Glossary
- Index

About 120 pages for V0.25.

- Initial
  - university seeking to establish SE graduate level program.
- Emerging
  - university can leverage GRCSE and SEBoK for self assessment/evaluation of their existing program
- Developed
  - university has formalized, assessed and validated outcomes and has a baseline set of intended objectives and has developed core, domain and program specific knowledge to support its objectives and outcomes
- Highly Developed
  - university has objectives and outcomes established, completely covers core knowledge, offers multiple concentrations, domain and program specific material based on stakeholder input and meets needs

# GRCSE 0.25 Feedback



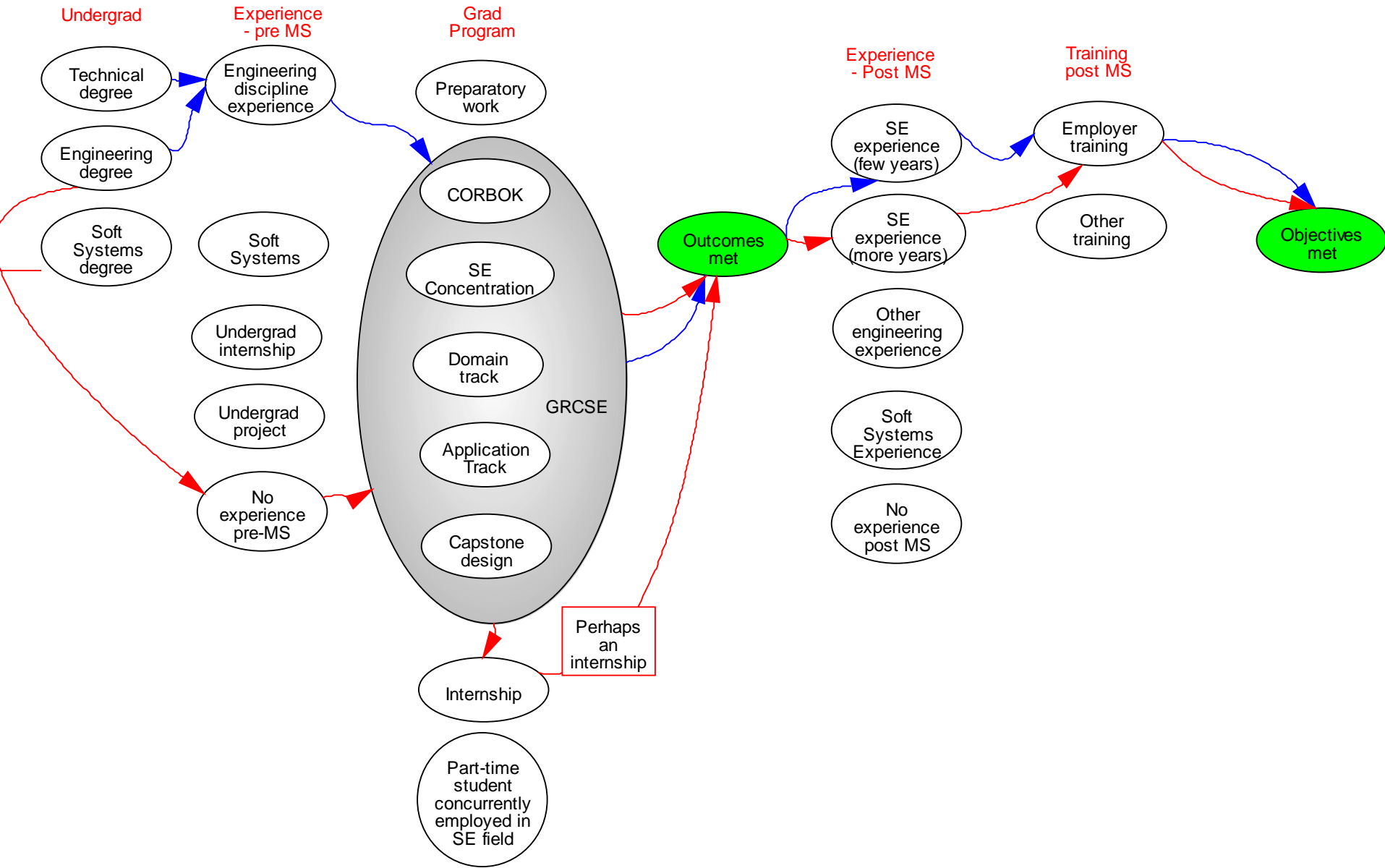
Undergrad only—holistic perspective on WFD

How do we compensate for the difference in order?

# Two paths

- There are many career progression models for a student.
- GRCSE will specifically address the two paths shown (next slide).
  - blue arrows indicate a North American model
  - the red arrows indicate a European model
- Objectives for a program are aligned with the dominant workforce competency development model associated with the program.

# Multiple Paths



# Current Thinking

- Two different educational systems (1 & 2)
  - Two different entrance expectations based on 2 models
  - Weave the rest around the expectations
  - Packaging will create two variants
  - Need to trace entrance to outcomes
  - CorBoK the same; Outcomes same or very similar (very clear); Objectives may be different; Architecture may be different (but some similarity)



# Thank You!

## Questions?

Alice F. Squires,  
alice.squires@stevens.edu  
School of Systems and Enterprises,  
Stevens Institute of Technology

This material is based upon work supported, in whole or in part, by the Systems Engineering Research Center (SERC). SERC is a federally funded University Affiliated Research Center managed by Stevens Institute of Technology.